



UNIVERSITI PUTRA MALAYSIA

**SOME ASPECTS OF THE BIOLOGY AND
POPULATION DYNAMICS OF GOATFISH, *Upeneus spp.*
IN TERENGGANU WATERS, PENINSULAR MALAYSIA**

PRIYANTO RAHARDJO

FPSS 1997 1

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**MASTER OF SCIENCE
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By

PRIYANTO RAHARDJO

**Thesis Submitted in Fulfilment of the Requirements
for the Degree of Master of Science in the
Faculty of Fisheries and Marine Science
Universiti Pertanian Malaysia**

January 1997



DEDICATION

This work is dedicated to my late father
Drs. Hj. Soegito Gito Sudarmo (deceased during my study,
innalillahi wa inna ilaihirraji'un).



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TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	viii
LIST OF FIGURES	xi
ABSTRACT	xvi
ABSTRAK	xviii
 CHAPTER	
I INTRODUCTION	1
Background	1
Research Problems	3
Objectives	5
II LITERATURE REVIEW	9
Geographical Distribution	10
Fish Population Dynamics	12
Growth Parameters	13
Mortality and Exploitation Rate	14
Some Aspects of Fish Biology	16
Taxonomy of <i>Upeneus shulphurus</i> and <i>Upeneus bensasi</i>	16
Food and Feeding Habits	18
Reproductive Biology	19
Length-Weight Relationship and Condition Factor	22
Fishery	23
III STUDY AREA	25
Introduction	25
Description of the Study Area	26
Weather and Sea Conditions	28



IV	SOME ASPECTS OF THE BIOLOGY OF GOATFISH	30
	Introduction	30
	Materials and Methods	31
	Sampling Procedure	31
	Maturity Stage and Maturation	34
	Size at Maturity	36
	Gonado-Somatic Index	38
	Length-Weight Relationship and Condition Factor	38
	Results	39
	Species Composition of Goatfish	39
	Length and Weight Measurement	39
	Spawning Seasons	44
	Discussion	53
V	THE POPULATION DYNAMICS OF GOATFISH	56
	Introduction	56
	Materials and Methods	58
	Sampling Procedure	58
	Growth Parameter Estimation	58
	Mortality Rate Estimation	73
	Recruitment	80
	Yield Per Recruit	81
	Fishery Management	86
	Results	88
	Growth Parameters	88
	Mortality Rates	116
	Yield Per Recruit	127
	Fishery Management	147
	Discussion	150
VI	SUMMARY AND CONCLUSION	166
	Summary	166
	Conclusion	169
	Requirements for Further Study	171



BIBLIOGRAPHY	174
APPENDICES	188
VITA	191



LIST OF TABLES

Table	Page
1. Asymtotic Length (L_{∞} in mm), Growth Coefficient (K , year ⁻¹), Phi Prime (Φ , $\ln K + 2 \ln L_{\infty}$) Total Mortality (Z , year ⁻¹) and Natural Mortality (M , year ⁻¹) of Goatfish from Different Fishing Areas	15
2. Relationships Between Total Length, tl (mm) and Weight, w (g) of <i>U. sulphureus</i> and <i>U. bensasi</i> from the Terengganu Waters in 1995-1996	40
3. Monthly Distribution of Maturity Stage (%) for Female <i>U. sulphureus</i> from Terengganu Waters in 1995-1996	46
4. Monthly Distribution of Maturity Stage (%) for Female <i>U. bensasi</i> from Terengganu Waters in 1995-1996	47
5. Maturity Classification by Length Category for Female <i>U. sulphureus</i>	48
6. Maturity Classification by Length Category for Female <i>U. bensasi</i>	48
7. Length at Maturity, l_m (mm), of <i>U. sulphureus</i> and <i>U. bensasi</i> Derived from the Logistic Equation	49
8. Length at First Maturity, l_m (mm), of <i>U. sulphureus</i> and <i>U. bensasi</i> Using Two Different Methods	51
9. The Sex Ratio (Male:Female) for <i>U. sulphureus</i> and <i>U. bensasi</i> Sample from Trawler Commercial Catches in the Terengganu Waters in 1995-1996	52
10. Monthly Length Frequency Distribution as the Sum of All Sample After Being Weight by CPUE, Number of Sample, and Number of Specimens of <i>U. sulphureus</i> from Terengganu Waters 1995 - 1996	89
11. Monthly Length Frequency Distribution as the Sum of All Sample After Being Weight by CPUE, Number of Sample, and Number of Specimens of <i>U. bensasi</i> from Terengganu Waters 1995 - 1996	90



12.	Length and Its Standard Deviation, and Calculated Number of Individuals Per Cohort, by Month, for <i>U. sulphureus</i> Based on Mixture Analysis of the Length Frequency Distribution Using Battacharya Method .	93
13.	Length and Its Standard Deviation, and Calculated Number of Individuals Per Cohort, by Month, for <i>U. bensasi</i> Based on Mixture Analysis of the Length Frequency Distribution Using Battacharya Method . .	94
14.	Lenth At Age Data for Cohort of <i>U. sulphureus</i> Based on Assumption of March 1 as the Respective Birth Dates	96
15.	The Estimates of the Grown Parameters of <i>U. sulphureus</i> by Using Gulland and Holt Plot, Allen, Munro's, Fabens' and Appledoorn's Method. Mean Length Obtained from the Mixture Analysis of Length Frequency Distribution Employing Bhattacharya's Method	96
16.	Annual Growth Increment (mm) for <i>U. sulphureus</i> in the Terengganu Waters in 1995-1996 Based on the Growth Parameters	98
17.	Lenth at Age Data for Cohort of <i>U. bensasi</i> in the Terengganu Waters	104
18.	The Estimates of the Grown Parameters of <i>U. bensasi</i> by Using Gulland and Holt Plot, Allen, Munro's, Fabens' and Appledoorn's Method. Mean Length Obtained from the Mixture Analysis of Length Frequency Distribution Employing Bhattacharya's Method	104
19.	Annual Growth Increment (mm) for <i>U. bensasi</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters	106
20.	The Estimates of the Growth Parameters of <i>U. sulphureus</i> and <i>U. bensasi</i> by Using Allen and Gulland and Holt Plot, Munro's, Fabens' and Appledoorn's Method. Mean Length Obtained from the Mixture Analysis of Length Frequency Distribution Employing Bhattacharya's Method. And Direct of Length Frequency Data by Using the ELEFAN Program, Powell-Wetheral Plot and Shepherd's Method	115



21.	The Relative Abundance of Successive Length Groups of <i>U. sulphureus</i> and <i>U. bensasi</i> Capture by Trawler from Terengganu Waters in 1995-1996	123
22.	The Estimate Z for <i>U. sulphureus</i> and <i>U. bensasi</i> Derived From the Analysis of Length Based Catch Curve, Jones and Valinge's, and Beverton and Holt Method Using Input Data Obtained From Eight Methods of Length Frequency Analysis	124
23.	Estimates of Natural Mortality Rate, M, for <i>U. sulphureus</i> and <i>U. bensasi</i> Derived from Alverson and Carney ,Pauly, and Rickhter and Efanov's Methods Using Input Data of the Growth Parameters Derived from Eight Methods of Length Frequency Analysis	126
24.	The Range of Value of K, L_{∞} , Z, and M as Derived from the Result of Various Methods of Analysis for <i>U. sulphureus</i> and <i>U. bensasi</i>	129
25.	Optimal Values of Lenth at First Capture lc^* (mm) as a Fungtion of E, M/K, and L_{∞} for <i>U. sulphureus</i>	132
26.	Optimal Values of Lenth at First Capture lc^* (mm) as a Fungtion of E, M/K, and L_{∞} for <i>U. bensasi</i>	133
27.	Length Frequency Distribution, Number of Sample, and Number of Specimens of <i>U. sulphureus</i> from Terengganu Waters 1995 - 1996	188
28.	Length Frequency Distribution, Number of Sample, and Number of Specimens of <i>U. bensasi</i> from Terengganu Waters 1995 - 1996	189



LIST OF FIGURES

Figure		Page
1.	Catch of Goatfish and Fishing Day Per Year by Trawl in East Coast Peninsular Malaysia	4
2.	The Basic Objective of Fish Population Dynamics	6
3.	Map Showing the Study Area	27
4.	The Length-Weight Relationship of <i>U. sulphureus</i> from Terengganu Waters (A = Logarithmic Curve, B = Normal Curve) . .	41
5.	The Length-Weight Relationship of <i>U. bensasi</i> from Terengganu Waters (A = Logarithmic Curve, B = Normal Curve) .	42
6.	Monthly Distribution of Mean Length of <i>U. sulphureus</i> and <i>U. bensasi</i> from Terengganu Waters in 1995-1996	44
7.	Relationships Between GSI (Gonado-somatic Index) and Maturity Stage of <i>U. sulphureus</i> and <i>U. bensasi</i> from Terengganu Waters in 1995-1996	45
8.	Maturity Ogive for <i>U. sulphureus</i> and <i>U. bensasi</i>	50
9.	Illustration of Method Calculation F_{01} .	85
10.	Monthly Length Frequency Histograms for <i>U. sulphureus</i> from Terengganu Waters in 1995 - 1996	91
11.	Monthly Length Frequency Histograms for <i>U. bensasi</i> from Terengganu Waters in 1995 - 1996	92
12.	Mean Size of <i>U. sulphureus</i> During Successive Months Based on the Result of the Bhattacharya Analysis	95
13.	The Fitted Von Bertalaffy Growth Curve for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Allen's Method	97
14.	Gulland and Holt Plot for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996	99



15.	Munro's Plot for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996	99
16.	The Fitted Von Bertalaffy Growth Curve for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Munro's Method	100
17.	Fabens' Plot for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996	100
18.	The Fitted Von Bertalaffy Growth Curve for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Fabens' Method	101
19.	The Fitted Von Bertalaffy Growth Curve for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Appeldoorn's Method	101
20.	Mean Size of <i>U. bensasi</i> During Successive Month Based on the Results of the Bhattacharya Analysis	102
21.	The Fitted Von Bertalaffy Growth Curve for <i>U. bensasi</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Allen Method	105
22.	Gulland and Holt Plot for <i>U. bensasi</i> in Terengganu Waters in 1995-1996	107
23.	Munro's Plot for <i>U. bensasi</i> in Terengganu Waters in 1995-1996	107
24.	The Fitted Von Bertalaffy Growth Curve for <i>U. bensasi</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Munro's Method	108
25.	Faben's Plot for <i>U. bensasi</i> in Terengganu Waters in 1995-1996	108
26.	The Fitted Von Bertalaffy Growth Curve for <i>U. bensasi</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Fabens' Method	109
27.	The Fitted Von Bertalaffy Growth Curve for <i>U. bensasi</i> in Terengganu Waters in 1995-1996 Based on the Growth Parameters Derived from Appeldoorn's Method	109



28.	Estimates of Growth Curves of <i>U. sulphureus</i> Derived Bhattacharya Method (A) and the ELEFAN Program (B)	111
29.	Estimates of Growth Curves of <i>U. bensasi</i> Derived Bhattacharya Method (A) and the ELEFAN Program (B)	112
30.	Modified Wetherall Plot for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996 . . .	113
31.	The Wetherall Plot of Cumulated Frequencies for <i>U. sulphureus</i> in Terengganu Waters in 1995-1996	113
32.	Modified Wetherall Plot for <i>U. bensasi</i> in the Terengganu Waters in 1995-1996 . . .	114
33.	The Wetherall Plot of Cumulated Frequencies for <i>U. bensasi</i> in Terengganu Waters in 1995-1996	114
34.	Estimation of Total Mortality Rates for Cohort of <i>U. sulphureus</i> Using Catch Curve Based on Growth Parameters Derived from Eight Methods of Analysis. A. Cohort Based on Allen; B. Cohort Based on Gulland and Holt; C. Cohort Based on Munro; D. Cohort Based on Fabens; E. Cohort Based on Appeldoorn; F. Cohort Based on ELEFAN ;G. Cohort Based on Powell and Wetherall; H. Cohort Based on Shepherds	117
35.	Estimation of Total Mortality Rates for Cohort of <i>U. bensasi</i> Using Catch Curve Based on Growth Parameters Derived from Eight Methods of Analysis. A. Cohort Based on Allen; B. Cohort Based on Gulland and Holt; C. Cohort Based on Munro; D. Cohort Based on Fabens; E. Cohort Based on Appeldoorn; F. Cohort Based on ELEFAN ;G. Cohort Based on Powell and Wetherall; H. Cohort Based on Shepherds	118
36.	Estimation of Total Mortality Rates for Cohort of <i>U. sulphureus</i> Using Jones and Valinge Based on Growth Parameters Derived from Eight Methods of Analysis. A. Cohort Based on Allen; B. Cohort Based on Gulland and Holt; C. Cohort Based on Munro; D. Cohort Based on Fabens; E. Cohort Based on Appeldoorn; F. Cohort Based on ELEFAN ; G. Cohort Based on Powell and Wetherall; H. Cohort Based on Shepherds	120



37.	Estimation of Total Mortality Rates for Cohort of <i>U. bensasi</i> Using Jones and Valinge Based on Growth Parameters Derived from Eight Methods of Analysis. A. Cohort Based on Allen; B. Cohort Based on Gulland and Holt; C. Cohort Based on Munro; D. Cohort Based on Fabens; E. Cohort Based on Appeldoorn; F. Cohort Based on ELEFAN ; G. Cohort Based on Powell and Wetherall; H. Cohort Based on Shepherds	121
38.	Estimated Annual Percentage Length Frequency Distribution for Goatfish from Terengganu Waters in 1995-1996	122
39.	Recruitment Pattern in <i>U. sulphureus</i> and <i>U. bensasi</i> Derived from ELEFAN Program Based on Growth Parameter $K = 1.30$ and $L_{\infty} = 230.00$ mm for the First Species and $K = 0.90$ and $L_{\infty} = 230$ mm for the Latter .	127
40.	Relative Yield Per Recruit (Y/R) of <i>U. sulphureus</i> Plotted Againsts Exploitation Rate (E) Employing Three Levels of M/K and Various Values of Relative Size at First Capture (c)	137
41.	Relative Yield Per Recruit (Y/R) of <i>U. sulphureus</i> Plotted Againsts Relative Size At First Capture (c), Employing Three Levels of M/K and Various Exploitation Rates (E), and $E_{0.1}$	138
42.	Relative Yield Per Recruit (Y/R) of <i>U. bensasi</i> Plotted Againsts Exploitation Rate (E) Employing Three Levels of M/K and Various Values of Relative Size at First Capture (c)	140
43.	Relative Yield Per Recruit (Y/R) of <i>U. bensasi</i> Plotted Againsts Relative Size at First Capture (c), Employing Three Levels of M/K and Various Exploitation Rates (E), and $E_{0.1}$	141
44.	Isopleths of Equal Relative Yield Per Recruit for <i>U. sulphureus</i> . The Current Status of the Fishery (CS) is Plotted on the Yield Isopleth for $M/K = 1.573$, Within the Range of Relative Length at First Capture $c = 0.448$ to 0.647 and $E = 0.451$ to 0.810 . The $E_{0.1}$ level (+) Correspondeds to $E = 0.557$ and $c = 0.40$. Relative Length at Maturity $cm (lm/L_{\infty} = 0.630$ to $0.652)$ is Indicated by Crosshatching	143



45. Isopleths of Equal Relative Yield Per Recruit for *U. bensasi*. The Current Status of the Fishery (CS) is Plotted on the Yield Isopleth for $M/K = 1.573$, Within the Range of Relative Length at First Capture $c = 0.448$ to 0.647 and $E = 0.451$ to 0.810 . The $E_{0.1}$ level (+) Corresponds to $E = 0.557$ and $c = 0.40$. Relative Length at Maturity cm ($lm/L_{\infty} = 0.630$ to 0.652) is Indicated by Crosshatching 144



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**SOME ASPECTS OF THE BIOLOGY AND
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By

PRIYANTO RAHARDJO

JANUARY 1997

Chairman : Assoc. Prof. Dr. Hj. Mohd. Zaki Mohd.Said

Faculty : Faculty of Fisheries and Marine Science

Two species of goatfish or Biji nangka, *Upeneus sulphureus* and *U. bensasi* play a significant role in the demersal trawl fishery in the Terengganu waters. Estimation of their population parameters, i.e., growth, reproductive behaviour, mortality rate, and assessment of the effect of changes in exploitation pattern were carried out, and alternative management measures for the fishery were examined.

Growth parameters were estimated based on modal progression analysis of length frequency distributions. Data on sexual maturity and seasonal changes in the gonadosomatic index were used to elucidate the reproductive biology of the two species. Length-based catch curves were used to estimate total mortality rate (Z) while empirical and indirect methods were used to estimate natural



mortality rate (M). Relative yield per recruit as a function of exploitation rate E , ($E = F/(F+M)$), ratio of natural mortality M and Von Bertalanffy growth parameter K , (M/K), and size at first capture (L_c), was used to analyze the effects of variability in the controlled variables E and/or L_c .

Estimates of the growth parameters derived from eight different methods were $K = 0.80$ to 1.45 , $L_\infty = 218.08$ to 232.00 mm for *U. sulphureus* and $K = 0.90$ to 1.38 , $L_\infty = 228.00$ to 243.31 mm for *U. bensasi*. Estimates of total mortality derived from three different methods employed varied ($Z = 3.30$ to 5.93 for *U. sulphureus* and $Z = 2.65$ to 5.57 for *U. bensasi*) so considerably that the validity of the methods was questioned. Further validation of the results derived from the length-based method is necessary. Estimates of natural mortality derived from three different methods for *Upeneus sulphureus* ($M = 1.01$ to 2.53) were less varied than for *Upeneus bensasi* ($M = 1.18$ to 2.84).

Finally, consideration of management policy using an $E_{0.1}$ criterion (analogous to $F_{0.1}$) showed that the current level of exploitation rate ($E = 0.63$) for *U. sulphureus* exceeded the estimate of the $E_{0.1}$ level ($E = 0.57$), while for *U. bensasi* ($E = 0.51$) it was below the $E_{0.1}$ level ($E = 0.67$).



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**BEBERAPA ASPEK BIOLOGI DAN DINAMIK POPULASI
IKAN BIJI NANGKA, *Upeneus* spp. DI PERAIRAN
TERENGGANU, SEMENANJUNG MALAYSIA**

OLEH

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JANUARI 1997

Pengerusi : Profesor Madya Dr. Hj. Mohd. Zaki Mohd. Said

Fakulti : Fakulti Perikanan dan Sains Samudera

Dua spesis ikan biji nangka atau goatfish, iaitu *Upeneus sulphureus* dan *Upeneus bensasi* memainkan peranan yang penting dalam perikanan demersal pukat tunda di perairan Terengganu. Penganggaran parameter populasi seperti tumbesaran, perlakuan pembiakan, kadar mortaliti dan maklumat berkenaan dengan kesan perubahan dalam corak eksploitasi dijalankan. Selain daripada itu, penilaian kepada pengurusan alternatif kepada perikanan ini juga diselidiki.

Parameter tumbesaran dianggar berdasarkan model analisis progresi taburan frekuensi panjang. Data kematangan seks dan perubahan musim dalam indeks gonado-somatik digunakan untuk menerangkan pembiakan biologi



kedua-dua spesies tersebut. Keluk penangkapan berdasarkan panjang digunakan untuk menganggar jumlah kadar mortaliti (Z), manakala kaedah tidak langsung dan empirikal digunakan untuk menganggarkan kadar mortaliti semulajadi (M). Hasil relatif bagi setiap pengambilan sebagai fungsi kepada kadar eksploitasi E , ($E = F/(F+M)$), nisbah kadar mortaliti M berbanding parameter tumbesaran Von Bertalanffy K , (M/K), dan saiz tangkapan pertama (L_c), digunakan untuk menganalisis kesan kepelbagaian dalam kepelbagaian kawalan E dan atau L_c

Lapan kaedah yang berlainan digunakan untuk menganggarkan parameter tumbesaran, dengan $K = 0.80$ hingga 1.45 , $L_\infty = 218.08$ hingga 232.00 mm untuk *Upeneus sulphureus* dan $K = 0.90$ hingga 1.38 , $L_\infty = 228.00$ hingga 243.31 mm untuk *Upeneus bensasi*. Anggaran bagi jumlah mortaliti diperolehi daripada tiga kaedah yang berlainan telah digunakan ($Z = 3.30$ hingga 5.93 untuk *Upeneus sulphureus* dan $Z = 2.65$ hingga 5.57 untuk *Upeneus bensasi*) menunjukkan perbezaan yang boleh diterima sehingga kesahihan kaedah tersebut dipersoalkan. Pengesahan selanjutnya keatas keputusan yang diperolehi daripada kaedah yang berdasarkan kepada panjang adalah diperlukan. Anggaran keatas mortaliti semulajadi yang diperolehi daripada tiga kaedah yang berbeza untuk *Upeneus sulphureus* ($M = 1.01$ hingga 2.53) mempunyai perbezaan yang kurang bagi *Upeneus bensasi* ($M = 1.18$ hingga 2.84).

Akhir sekali, Pengurusan yang menggunakan kriteria $E_{0.1}$ (analogos kepada $F_{0.1}$) menunjukkan kadar eksploitasi pada tahap terkini ($E=0.63$) untuk *Upeneus sulphureus* adalah jauh melebihi paras anggaran oleh $E_{0.1}$ ($E = 0.57$), manakala bagi *Upeneus bensasi* ($E = 0.51$), nilainya adalah lebih rendah daripada paras $E_{0.1}$ ($E = 0.67$).

CHAPTER I

INTRODUCTION

Background

Malaysia lies within the latitude 1° N to 8° N and longitude 100° E to 119° E comprising Peninsular Malaysia, Sabah and Sarawak. Peninsular Malaysia is bounded by Thailand in the north, Singapore in the south, South China Sea in the east and Sumatra to the west. Sabah and Sarawak are located on eastern Kalimantan island. The two land masses, Peninsular Malaysia and Sabah and Sarawak are about 1,200 km² apart separated by the southwestern portion of the South China Sea. The coast line of Sabah, Sarawak and east coast of Peninsular Malaysia lie next to the South China Sea, while the west coast is bordered by the Andaman Sea to the north and Java Sea to the south.

Fishing industry plays an important role in the social economy of Malaysia. It supplies two-thirds of the total animal protein consumed by the population (Merican, 1980). Furthermore, adequate supply of protein rich food is vital to health, especially for the lower income groups.



Also, it contributes to the national income through earnings from foreign exchange of fish and fishery products.

The marine fisheries can be categorised as municipal and commercial fishing. Municipal or sustenance fishing occurs in the inshore waters using either powered or non-powered vessels. The powered vessel can be with an out-board engine or in-board engine.

The commercial fisheries operate in waters beyond the inshore areas. The gears used included otter trawls, purse seines, gill nets, drive-in-nets (muro-ami), traps, hooks and lines and others. Operation of this category is normally beyond 12 mile zone but within the continental shelf, except for some purse seining and drive-in net operations. At present, the total landings of marine fish from Malaysia amount to 930,049 metric tons, 27.45% of which are from the east coast and 46.44% from west coast (Ministry of Agriculture Malaysia, 1995).

Based on the behavioural pattern of fish resources, marine fishing in Malaysia can be categorised into pelagic and demersal fisheries. Pelagic fisheries are mainly concentrated on the migratory species and these are sometimes seasonal in nature. The main gear is the purse seine that has accounted for 17.00% of the total landings of marine fish in Peninsular Malaysia in 1994 (Ministry



of Agriculture Malaysia, 1995). The demersal fisheries are mainly concentrated on the bottom and sometimes mesopelagic species.

The most important and widely used gear in demersal fisheries is the trawl net. The trawl catch contributes the most tonnage in demersal fisheries landings, accounting for as high as 90.00% of the total landing. This share in marine landings has been increasing since the establishment of fisheries. In 1994, the trawl landings were 587,928 metric tonnes, which accounted for 54.00% of the total marine fish landing in Peninsular Malaysia (Ministry of Agriculture Malaysia, 1995).

Research Problems

Aquatic living resources such as goatfish resources are limited but renewable. Exploitation of these resources must be carefully planned, because after a certain level of exploitation the renewal of the resources cannot keep pace with the removal caused by fishing, and a further increase in exploitation level leads to reduction in yield. For example, the annual catch of goatfish decreased from about 4,900 mt in 1988 to 2,000 in 1991, while the number of fishing days (Fishing effort) increased from 275,471 to 346,388 (Figure 1).

The development of the fishing activities (including trawl fisheries) cannot be pursued indefinitely without giving serious concern to the status of the stocks.

